Claims

1. A semiconductor device for the detection of a target DNA or RNA, said device being composed of:

(i) at least one layer of a conducting semiconductor;

(ii) at least one insulating or semi- insulating layer;

(iii) at least one single-stranded DNA probe directly adsorbed on the surface of an upper layer which is either a conducting semiconductor layer (i) or an insulating or semi-insulating layer (ii); and

(iv) two conducting pads on the upper layer making electrical contact with the conducting semiconductor layer (i), such that electrical current can flow between them at a finite distance from the surface of the device.

2. A semiconductor device according to Claim 1, said device being composed of one or more insulating or semi-insulating layers (1), one conducting semiconductor layer (2), two conducting pads (3), and a layer of at least one single-stranded DNA probe (4), characterized in that:

said conducting semiconductor layer (2) is on top of one of said insulating or semi-insulating layers (1),

said two conducting pads (3) are on both sides on top of an upper layer which is either said conducting semiconductor layer (2) or another of said insulating or semi-insulating layers (1), making electrical contact with said conducting semiconductor layer (2),

and said at least one single-stranded DNA probe (4) is adsorbed on the surface of said upper layer, between the two conducting pads (3).

3. A semiconductor device for the detection of a target DNA or RNA, said device being composed of:

(i) at least one layer of a conducting semiconductor;

(ii) at least one insulating or semi- insulating layer;

(iii) an upper layer which is either a conducting semiconductor layer (i) or an insulating or semi-insulating layer (ii) on the surface of which upper layer can be directly adsorbed at least one single-stranded DNA probe; and

(iv) two conducting pads on the upper layer making electrical contact with the conducting semiconductor layer (i), such that electrical current can flow between them at a finite distance from the surface of the device.

4. A semiconductor device according to Claim 3, said device being composed of one or more insulating or semi-insulating layers (1), one conducting semiconductor layer (2), and two conducting pads (3), characterized in that:

said conducting semiconductor layer (2) is on top of one of said insulating or semi-insulating layers (1),

said two conducting pads (3) are on both sides on top of an upper layer which is either said conducting semiconductor layer (2) or another of said insulating or semi-insulating layers (1), making electrical contact with said conducting semiconductor layer (2),

and whereby on the surface of said upper layer, between the two conducting pads (3), may be directly adsorbed a layer of at least one single-stranded DNA probe (4) .

5. A semiconductor device according to any one of Claims 1-4, wherein said conducting semiconductor layer (2) is a semiconductor selected from a III-V and a II-VI material, or mixtures thereof, wherein III, V, II and VI denote the Periodic Table elements III =Ga, In; V=As, P; II=Cd, Zn; VI=S, Se, Te.

6. A semiconductor device according to any one of Claims 1-5, wherein said conducting semiconductor layer (2) is doped n-GaAs or doped n-(Al,Ga)As.

7. A semiconductor device according to any one of Claims 1 to 6, wherein the one or more insulating or semi-insulating layers (1), that may serve as the base for the device, is a dielectric material selected from the group consisting of silicon

oxide, silicon nitride and an undoped semiconductor selected from a III-V and a II-VI material, or mixtures thereof, wherein III, V, II and VI denote the Periodic Table elements III =Ga, In; V=As, P; II=Cd, Zn; VI=S, Se, Te.

8. A semiconductor device according to Claim 7, wherein said undoped semiconductor is undoped GaAs or undoped (Al,Ga)As.

9. A semiconductor device according to any one of Claims 1 to 8, wherein said conducting semiconductor layer (2) of doped n-GaAs is on top of a semi-insulating layer (1) of (Al,Ga)As which is on top of another semi-insulating layer (1) of GaAs, and on top of said conducting semiconductor doped n-GaAs layer (2) there is a semi-insulating undoped GaAs layer (1) to which is attached said layer of said at least one single-stranded DNA (4) probe.

10. A semiconductor device according to any one of Claims 1 to 8, wherein said conducting semiconductor layer (2) of doped n-(Al,Ga)As is on top of an insulating layer (1) of undoped GaAs which is on top of a semi-insulating layer (1) of GaAs, on top of said conducting semiconductor doped n-(Al,Ga)As layer (2) there is a semi-insulating undoped (Al,Ga)As layer (1) on top of which there is an upper undoped GaAs semi-insulating layer (1), and said layer of at least one single-stranded DNA probe (4) is attached to the upper undoped GaAs semi-insulating layer (1).

11. A semiconductor device according to any one of Claims 1 to 10, wherein said at least one single-stranded DNA probe comprises a sequence complementary to a sequence of a target DNA or RNA.

12. A semiconductor device according to Claim 11, wherein said at least one single-stranded DNA probe comprises a sequence complementary to a mutation sequence of a gene responsible for a genetic disease or disorder.

13. A semiconductor device according to Claim 12, comprising two or more single-stranded DNA probes each of said probes comprising a sequence being complementary to a mutation sequence of a gene responsible for a genetic disease or disorder.

14. An array of semiconductor devices according to any one of Claims 1 to 10, wherein each device in the array carries a different DNA probe.

15. An array of semiconductor devices according to Claim 14, wherein at least one of said devices in the array carries a DNA probe comprising a sequence complementary to a sequence of a target DNA or RNA.

16. An array of semiconductor devices according to Claim 15, wherein at least one of said devices in the array carries a DNA probe comprising a sequence complementary to a mutation sequence of a target gene responsible for a disease or disorder and at least another of said devices in the array carries a control DNA probe comprising a sequence complementary to the sequence of the normal gene corresponding to said mutation.

17. A method for the detection of a target DNA or RNA which comprises:

(i) exposing the single-stranded DNA probe of at least one semiconductor device according to any one of claims 1 to 10 or of an array according to claim 14, to a sample containing the target DNA or RNA, under hybridization conditions; and

(ii) monitoring either the current change resulting from the hybridization process when a constant electric potential is applied between the two conducting pads or measuring the change in the electric potential required to keep a constant current.

18. A method according to claim 17, wherein said single-stranded DNA probe comprises a sequence complementary to a sequence of said target DNA or RNA.